CLAIMS

1. A method of plasma-etching an organic material film formed on a substrate with an inorganic material film used as a mask, by means of a parallel plate type plasma-etching apparatus; wherein

the organic material film is plasma-etched with:

a high-frequency power of a frequency of 40 MHz or above for generating plasma; and

a process gas including an ionization accelerating gas that is ionized from a ground state or metastable state with an ionization energy of 10 eV or below and has a maximum ionization cross-section of 2×10^{-16} cm^2 or above, and a molecular gas.

2. The method according to claim 1, wherein

a plasma-etching apparatus is used, the apparatus including: a process vessel into which the process gas is supplied; and parallel plate electrodes disposed in the process vessel, the electrodes being constituted by a support electrode on which the substrate is supported, and a counter electrode that is opposed to the support electrode; and

the high-frequency power for generating the plasma is applied to the support electrode.

3. The method according to claim 2, wherein

a high-frequency power of a frequency of 500 kHz to 27 MHz for drawing ions is further applied to the support electrode, such that an absolute value of the self-bias voltage of the support electrode is 500 V or below.

4. The method according to claim 1, wherein

a plasma-etching apparatus is used, the apparatus including: a process vessel into which the process gas is supplied; and parallel plate electrodes disposed in the process vessel, the electrodes being constituted by a support electrode on which the substrate is supported, and a counter electrode that is opposed to the support electrode; and

the high-frequency power for generating the plasma is applied to the counter electrode; and

a high-frequency power of a frequency of 500 kHz to 27 MHz for drawing ions is applied to the support electrode, such that an absolute value of the self-bias voltage of the support electrode is 500 V or below.

5. The method according to claim 3, wherein

the process gas includes Ar as the ionization accelerating gases, and N_2 and H_2 as the molecular gas.

6. The method according to claim 3, wherein

the process gas includes Ar as the ionization accelerating gas and NH_3 as the molecular gas.

7. The method according to claim 3, wherein

a frequency of the high-frequency power for generating the plasma is 100 MHz.

8. The method according to claim 3, wherein

a distance between the support electrode and the counter electrode in the parallel plate electrodes is 40 mm or below.

9. An apparatus for plasma-etching an organic material film formed on a substrate with an inorganic material film used as a mask, comprising:

a process vessel that contains the substrate;

parallel plate electrodes disposed in the process vessel, the electrodes being constituted by a support electrode on which the substrate is supported, and a counter electrode that is opposed to the support electrode;

a process gas supply system that supplies a process gas into the process vessel;

an evacuating system that evacuates an atmosphere of the process vessel; and

a first high-frequency power source that supplies a high-frequency power for generating plasma to the support electrode; wherein

the first high-frequency power source supplies a high-frequency power of a frequency of 40 MHz or above; and

the process gas supply system supplies a process gas including an ionization accelerating gas that is ionized from a ground state or metastable state with an ionization energy of 10 eV or below and has a maximum ionization cross-section of 2×10^{-16} cm^2 or above, and a molecular gas.

10. The apparatus according to claim 9, further comprising:

a second high-frequency power source that supplies a high-frequency power of a frequency of 500 kHz to 27 MHz for drawing ions to the support electrode, such that an absolute value of the self-bias voltage of the support electrode is 500 V or below.

11. An apparatus for plasma-etching an organic material film formed on a substrate with an inorganic material film used as a mask, comprising:

a process vessel that contains the substrate;

parallel plate electrodes disposed in the process vessel, the electrodes being constituted by a support electrode on which the substrate is supported, and a counter electrode that is opposed to the support electrode;

a process gas supply system that supplies a process gas into the process vessel;

an evacuating system that evacuates an atmosphere of the process vessel;

a first high-frequency power source that supplies a high-frequency power for generating plasma to the counter electrode; and

a second high-frequency power source that supplies a high-frequency power for drawing ions to the support electrode; wherein

the first high-frequency power source supplies a high-frequency power of a frequency of 40 MHz or above;

the second high-frequency power source supplies a high-frequency power of a frequency of 500 kHz to 27 MHz, such that an absolute value of the self-bias voltage of the support electrode is 500 V or below; and

the process gas supply system supplies a process gas including an ionization accelerating gas that is ionized from a ground state or metastable state with an ionization energy of 10 eV or below and has a maximum ionization cross-section of 2×10^{-16} cm^2 or above, and a molecular gas.

12. The apparatus according to claim 10, wherein

a frequency of the high-frequency power supplied by the first high-frequency power source is 100 MHz.

13. The apparatus according to claim 10, wherein

a distance between the support electrode and the counter electrode in the parallel plate electrodes is 40 mm or below.